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	Prepared by(s) J. Eric Grove, William Raynor	Supersedes None
	Subsystem/Office Calorimeter Subsystem	
Document Title **CAL Flight Crystal Detector Element Specification**		

Gamma-ray Large Area Space Telescope (GLAST)

Large Area Telescope (LAT)

Calorimeter Flight Model

Crystal Detector Element Specification

DOCUMENT APPROVAL

Prepared by:

J. Eric Grove
CAL Subsystem Scientist

Date

William Raynor
CAL Subsystem Project Manager

Date

Approved by:

Nick Virmani
CAL Quality Assurance Manager

Date

W. Neil Johnson
CAL Subsystem Manager

Date

CHANGE HISTORY LOG

Revision	Effective Date	Description of Changes
01	22 Nov 2002	Initial Release
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Table of Contents

List of Figures

List of Tables

1 INTRODUCTION

1.1 PURPOSE

This document describes the requirements for the Flight Crystal Detector Element (CDE) of the Calorimeter (CAL) derived from level IV detailed system requirements for the GLAST Large Area Telescope (LAT) Calorimeter (CAL).

1.2 SCOPE

This document is one level below the LAT-CAL Subsystem-Level-IV Specification LAT-SS-00210.

This specification captures the LAT overall requirements for the CDE. This encompasses the subsystem level requirements and the design requirements for the CAL.

1.3 APPLICABLE DOCUMENTS

The following documents are applicable to the extent specified within. Unless otherwise indicated, the latest issue in effect shall apply. In the event of a conflict between these documents and the contents of LAT-SS-01133, those contained herein shall be considered the superseding requirement.

GE-00010	GLAST LAT Performance Specification
LAT-SS-00010	LAT Performance Specification – Level II (b) Specification
LAT-SS-00018	LAT CAL Subsystem Specification - Level III Specification
LAT-SS-00210	LAT CAL Subsystem Specification – Level IV Specification
LAT-SS-00601	LAT Calorimeter Structure to CDE Interface Control Document
LAT-TD-00381	LAT Calorimeter CDE Light Yield Calibration Procedure
LAT-PS-00809	LAT Calorimeter CsI Crystal Handling and Shipping Procedure
LAT-DS-00820	LAT Calorimeter CsI Crystal Performance Specification
LAT-DS-00209	LAT Calorimeter Flight Dual PIN Photodiode Specification
LAT-PS-01330	Calorimeter Flight Photodiode Assembly Soldering & Staking Process Specification
LAT-PS-01534	Calorimeter Flight Model Photodiode Assembly Specification
LAT-PS-01331	Calorimeter Flight Crystal to PDA Bonding Process Specification
LAT-PS-01332	Calorimeter Flight Crystal Wrapping and Capping Process Specification
LAT-MD-00228	Calorimeter, Tracker, and Data Acquisition Contamination Control Plan
LAT-PS-02235	Calorimeter Flight Model Crystal Detector Element Acceptance Test Plan
LAT-PS-02236	Calorimeter Flight Model Crystal Detector Element Qualification Plan
LAT-PS-02594	Flight Crystal Detector Element Muon Optical Test Procedure
LAT-DS-01900	Crystal Detector Element Assembly Drawing
LAT-DS-02159	GLAST Crystal Wrapper Drawing

1.3.1 Reference Documents

The following documents are listed for reference purposes:

GEVS-SE	Goddard Environmental Verification Specification
433-MAR-0004	Mission Assurance Requirements (MAR) for the Large Area Telescope (LAT) Phase C/D/E, NASA Goddard Space Flight Center
NPD 8010.2B	NASA Policy Directive, Use of Metric System of Measurement in NASA Programs

1.4 DEFINITIONS AND ACRONYMS

1.4.1 Acronyms

CAL	Calorimeter Subsystem of the LAT
CDE	Crystal Detector Element

DPD	Dual PIN photoDiode
GEVS	General Environmental Verification Specification
GLAST	Gamma-Ray Large Area Space Telescope
LAT	Large Area Telescope
MAR	Mission Assurance Requirements
PDA	PhotoDiode Assembly
PEM	Pre-Electronics Module of the CAL
TBC	To Be Confirmed
TBD	To Be Determined
TBR	To Be Resolved

1.4.2 Definitions

Analysis	A quantitative evaluation of a complete system and/or subsystems by review/analysis of collected data
Demonstration	To prove or show, usually without measurements of instrumentation, that the project/product complies with requirements by observation of the results.
Inspection	To examine visually or use simple physical measurement techniques to verify conformance to specified requirements.
Simulation	To examine through model analysis or modeling techniques to verify conformance to specified requirements
Testing	A measurement to prove or show, usually with precision measurement or instrumentation, that the product complies with requirements.
Validation	Process used to assure the requirement set is complete and consistent, and that each requirement is achievable.
Verification	Process used to ensure that the selected solutions meet specified requirements and properly integrate with interfacing products
γ	gamma ray
µsec, µs	microsecond, 10^{-6} second
nm	nanometer
µm	micrometer
mm	millimeter
eV	electron Volt
MeV	Million electron Volt, 10^{6} eV
ph	photons

2 REQUIREMENTS

2.1 CDE CONCEPT

The Crystal Detector Element (CDE) is the detection unit of the calorimeter subsystem. It uses the scintillation properties of the CsI(Tl) to determine with excellent accuracy the energy deposited by interacting particles. The primary scientific characteristics of the CDE are the Light Yield, expressed in terms of electrons/MeV at the output of the read out system (photodiodes), and its position dependence.

2.2 DESIGN OVERVIEW

CsI crystals are wrapped in a reflective material to achieve high light collection efficiency and are read out by dual PIN photodiodes (DPDs) bonded to each end. An optical adhesive is used to bond the DPDs on the crystal end faces. The adhesive preserves the high light yield and mechanical stability required over the large design temperature range. The reflectivity of the wrapping is chosen to preserve high light yield, and the geometry of the wrap is chosen to permit insertion of completed CDEs into the mechanical structure. Two sets of interconnect wire pairs are soldered to each DPD for connection to the front-end electronics. The four long corners of the crystal are chamfered and, along with the crystal end faces not covered with DPDs, are used for mounting surfaces within the mechanical structure. The CDE concept is shown in Figure 1.

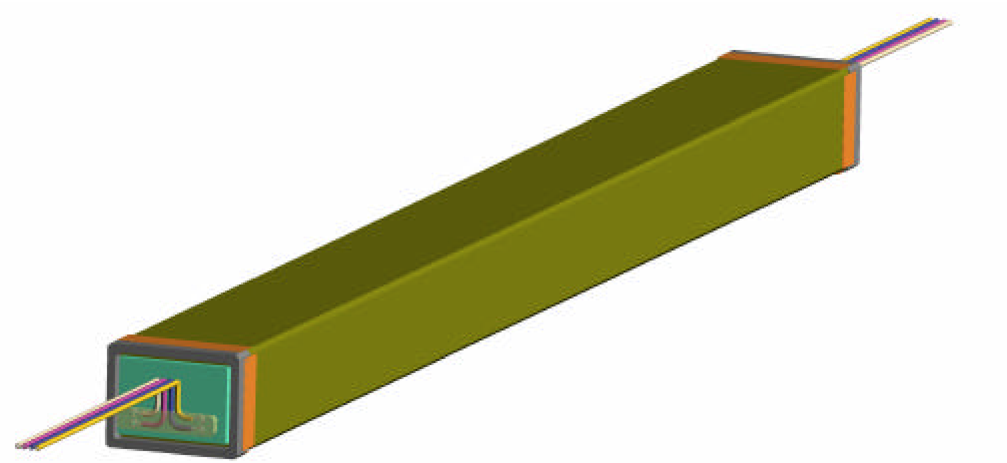

Figure 1. Crystal Detector Element assembly. Note that the CDE is depicted with its "top" surface – with the seam-sealing tape – down. The seal tape is therefore not shown. The CDE Assembly Drawing is LAT-DS-1900.

2.3 OPTICAL PERFORMANCE REQUIREMENTS

The optical performance of each flight CDE shall be measured with cosmic ray muons in the CDE Muon Telescope. Use of the telescope is described in the CDE Muon Optical Test Procedure, LAT-PS-02594. In addition, the energy resolution of Engineering Model CDEs shall be measured in a high-energy carbon beam.

2.3.1 Absolute Light Yield

The light yield produced by cosmic muons crossing within ±3 cm of the center of the crystal shall be greater than 7000 electrons per MeV for the large diode and greater than 1100 electrons per MeV for the small diode [LAT-SS-00210 / 6.2.1 and 6.2.2]. Refer to the CDE Muon Optical Test Procedure (LAT-PS-02594) and Calorimeter CDE Light Yield Calibration technical note (LAT-TD-00381) for details on CDE Light Yield measurement.

This requirement shall be verified on all CDEs.

2.3.2 End-to-End Light Yield Ratio

The ratio, P/M, of the light yield, P, of the large diode on the Plus face to the light yield, M, of the large diode on the Minus face, shall be between 0.87 and 1.15 for energy depositions within ±3 cm of the central point of the crystal.

This requirement shall be verified on all CDEs.

2.3.3 Large-to-Small Diode Light Yield Ratio

The ratio of light yields between the large and small diodes of each PDA shall be between 5 and 7 for energy depositions within ±3 cm of the central point of the crystal.

This requirement shall be verified on all CDEs.

2.3.4 Energy resolution

2.3.4.1 Carbon Energy Resolution

The energy resolution (1σ) shall be better than 2% for high energy (100 to 1000 MeV/nucleon) Carbon ions of normal incidence at a central point in the crystal with a beam spot size < 3 mm diameter. [LAT-SS-00018-09, Sect. 5.3.4]

This requirement shall be tested in accelerator beams on the Engineering Model. This requirement shall be not verified on Flight CDEs.

2.3.4.2 Muon Energy Resolution

The width of the distribution of measured energies from sea-level muons (energy resolution, 1 sigma) shall be <8% within ±3 cm of the central point of the crystal.

This requirement shall be verified on all CDEs. This verification will be repeated on all CDEs at the PEM level. The resolution shall be deduced from the width of the distribution of the difference in signals of the two large diodes, as given in the following expression: sigma(mu) = sigma(Diff) / sqrt(2), where sigma(mu) is the deduced energy resolution for muons as measured in a single large diode and sigma(Diff) is the measured rms of the distribution of normalized differences (P-M) / ((P+M)/2) in the signal from the large diodes of the Plus (P) and Minus (M) faces. This test may be performed with laboratory electronics of arbitrarily low noise performance.

2.3.5 Light Yield Asymmetry

The change in light asymmetry measure shall be between 0.25 and 0.70 for energy depositions centered at two locations symmetrically placed on the crystal, each 12 cm from the center of the crystal. The asymmetry measure is defined as the ratio (P−M) / (P+M), where P = signal in large diode at the "plus" end and M = signal in large diode at "minus" end. [Derived from LAT-SS-00210, Sect. 6.4.6. Consistent with light tapering satisfying Sect. 2.3.6 in LAT-SS-01133]

The center of the fiducial locations may vary within the range 11 cm to 13 cm, and energy depositions may be accepted within a region ± 1.5 cm in longitude about each of the fiducial locations. If the fiducial locations are not placed identically at 12 cm, the minimum and maximum specifications for change in light asymmetry shall be calculated from the following expression:

$$\text{dAsymSpec} = 2 * (pp - pm) / (pp + pm)$$

where: pp = 1 – slope * (32.6/2 – fid) = response from Plus face at plus fiducial

pm = 1 – slope * (32.6/2 + fid) = response from Plus face at minus fiducial

fid = the fiducial location (e.g. 12.0 cm)

slope = (1 − 0.75) / (32.6 − 4.0) for the minimum spec and slope = (1 − 0.45) / (32.6 − 4.0) for the maximum spec, as referenced in the Light Tapering specification, Section 2.3.6.

the crystal length is taken to be 32.6 cm

This requirement shall be verified on all CDEs.

2.3.6 Light Tapering

The dependence of light yield in the large diode on the position of energy deposition along the crystal is defined as the “light taper.” The light taper shall be monotonically decreasing such that the light yield at 2 ± 1 cm from the opposite crystal face shall be 60% ± 15% of the light yield at 2 ± 1 cm from the crystal face to which the large diode is bonded. Interpolation between measured points shall be permitted in the calculation of the light taper between the fiducial points. Extrapolation beyond measured points is forbidden.

This requirement shall be verified on all CDEs prior to shipment to the US.

2.3.7 Verification

All optical performance requirements shall be met between 19°C and 25°C. CDEs shall satisfy the optical performance requirements within this temperature range.

Tests of the optical performance of CDEs shall be made with CR-RC shaping with 3.5 ± 0.5 μs time-to-peak. This configuration has been chosen to simulate the characteristics of the flight shaping amplifiers. Refer to the the CDE Muon Optical Test Procedure (LAT-PS-02594) and Calorimeter CDE Light Yield Calibration technical note (LAT-TD-00381) for details on CDE optical performance measurements.

2.4 CDE COMPOSITION

The Flight CDE assembly consists of the following components. These are depicted in Figure 1. The CDE assembly drawing is LAT-DS-01900.

- One FM CsI(Tl) scintillating crystal, which is a rectangular parallelepiped with a chamfer on the corners of the long dimension, as defined in LAT-DS-00820.
- Two FM Photodiode Assemblies (PDAs), one bonded to each end of the CsI crystal. As defined in LAT-PS-01534, each PDA consists of:
    - One Dual PIN photoDiode (DPD) as defined in LAT-DS-00209, and
    - Two sets of interconnect wire pairs attached to the leads of the DPD.
- Two optical bonds attaching the PDA assemblies, one to each CsI crystal end using a DC93-500 silicone optical adhesive in accordance with LAT-PS-01331.
- One VM2000 Optical Reflective Wrap sealed with acrylic-adhesive Kapton tape applied in accordance with LAT-PS-01332.
- Two Machined End Caps attached over bonded PDAs and optical reflective wrap at both ends of the crystal to close out the ends of the CDE in accordance with LAT-PS-01332.
- One label indicating crystal serial number and orientation as defined in the FM CDE Specification (LAT-SS-01133).

2.4.1 CsI (Tl) Crystal

The CsI crystals shall comply with the optical and mechanical specifications given in the Calorimeter CsI Crystal Performance Specification, LAT-DS-00820. Details concering the physical dimensions and tolerances with respect to the Flight CDE CsI Crystal may be found both in the above-mentioned document and the CsI Crystal drawing, LAT-DS-01115. A representation of the CsI crystal is shown in Figure 2.

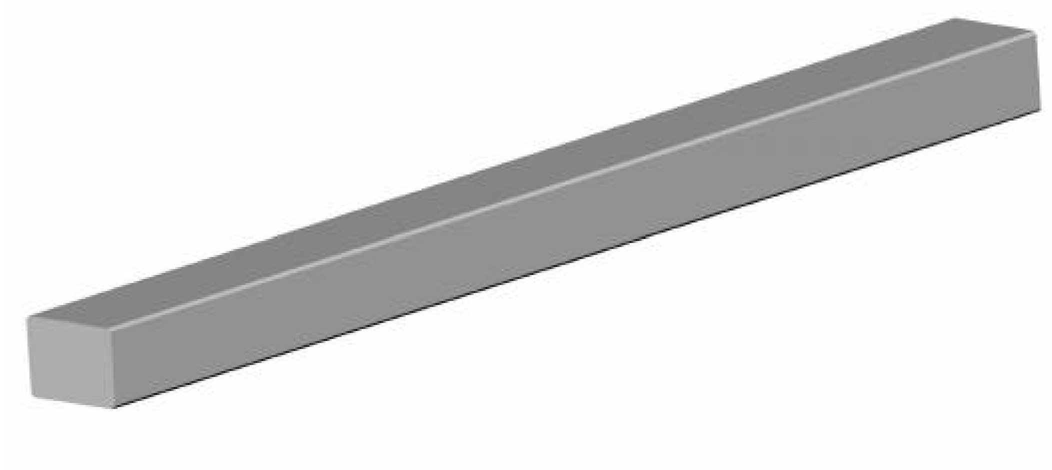

Figure 2. CsI Crystal

2.4.2 Photodiode Assembly

The PhotoDiode Assembly (PDA) is comprised of two sets of interconnect wire pairs soldered and staked to a Dual PIN Photodiode (see LAT-SS-01534, Flight Photodiode Assembly Specification). Figure 3 shows the orientation of the interconnect wires and staking on the Dual PIN Photodiode.

2.4.2.1 Dual PIN Photodiode

The Dual PIN photoDiode (DPD) shall comply with the specifications in the Calorimeter Flight Dual PIN Photodiode Specification, LAT-DS-00209.

2.4.2.2 Interconnect Wire Pairs

The interconnect wire pairs shall be soldered and staked in accordance with the Calorimeter Flight Photodiode Assembly Soldering & Staking Process Specification, LAT-PS-01330. Each wire shall be 99 mm in length from the edge of the the diode carrier. Of this, 5 mm shall be stripped for soldering into the test connector.

2.4.3 Crystal – PDA Bonding

2.4.3.1 Bonding Specification

The PDAs shall be bonded to the crystal ends with an optically transparent adhesive (Dow Corning DC 93-500 with primer Dow Corning DC 92-023) that maintains optical and mechanical performance over the qualification temperature range and under qualification mechanical test levels of the CAL module.

The bond thickness shall be 0.9 ± 0.1 mm. Bond material shall not extend beyond the footprint of the PDA on the crystal end face. This bonding shall be performed in accordance with the Calorimeter Flight Crystal to PDA Bonding Process Specification, LAT-PS-01331.

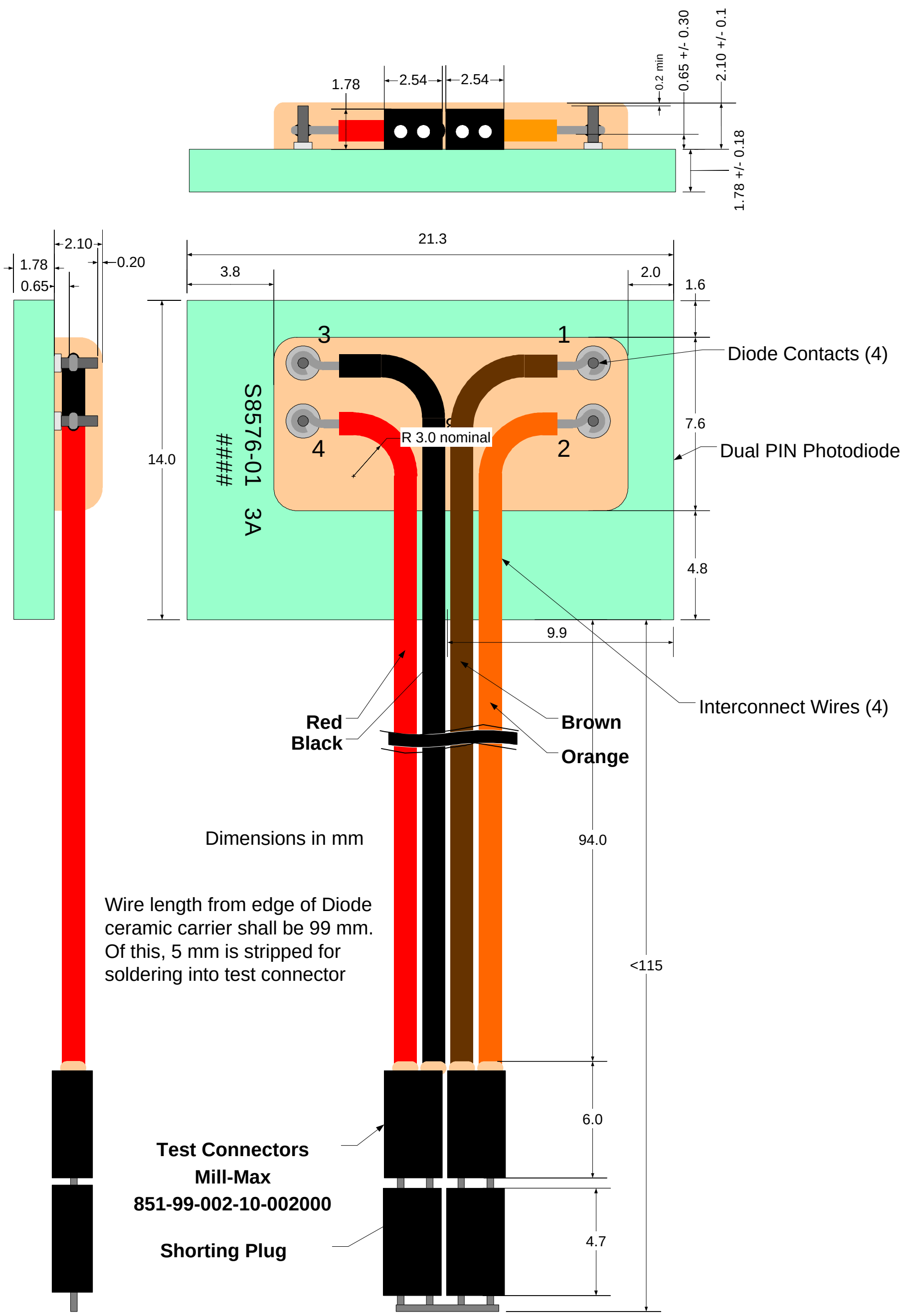

Figure 3. Photo Diode Assembly: DPD with interconnect wires installed

2.4.3.2 PDA Positioning on the Crystal

The PDAs shall be positioned on the CsI crystal end faces such that they will not contact the end cap. This results in positioning of the PDAs on the crystal end faces with the dimensions and tolerances shown in Figure 4. Note that for reference purposes, the "top" surface of the crystal is identified with a scribe mark as detailed in the CsI Crystal Performance Specification, LAT-DS-00820. The PDA location shall be referenced from the "top" crystal surface, when viewed end on, as indicated in Figure 4. Note also the locations of the four diode pins and the PDA serial number in relation to the crystal surfaces. When viewed from either end of the crystal, the diode pins shall be located in the top half of the end face, and the PDA serial number shall be to the left of the axis of symmetry of the crystal.

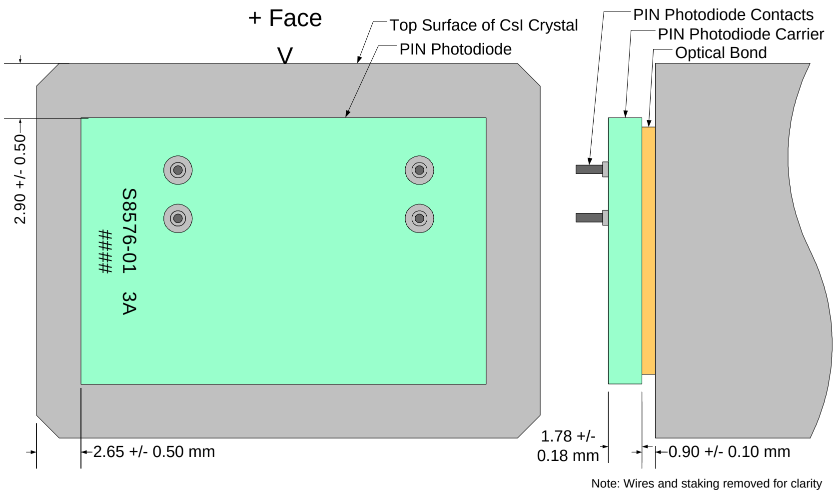

Figure 4. PDA Positioning on Plus Face of Crystal

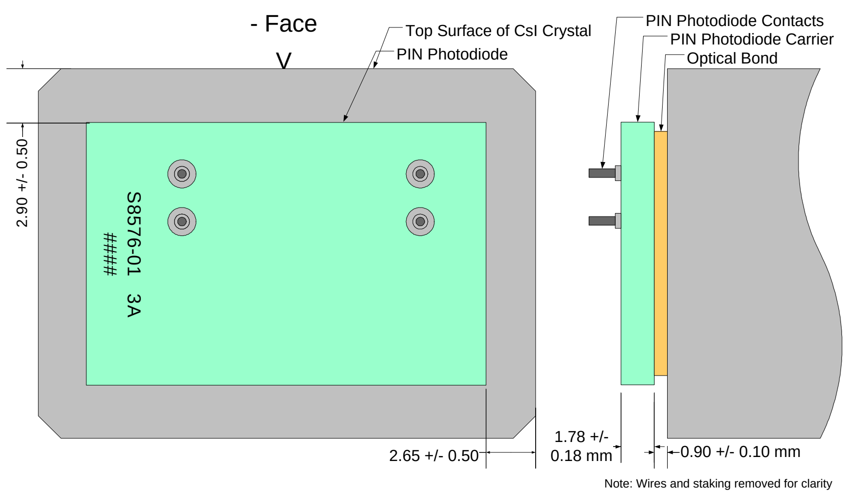

Figure 5 . PDA Positioning on Minus Face of Crystal

2.4.4 Optical Reflective Wrap

The crystal shall be wrapped in reflective material (3M Corp. VM2000) to meet the optical specifications defined herein and mechanical specifications for easy insertion within the Calorimeter mechanical structure. The wrapping shall be performed in accordance with the Flight CDE Wrapping and Capping Procedure, LAT-PS-01332, using wraps molded from VM2000 blanks cut according to LAT-DS-02159. The orientation of the optical reflective wrap on the bonded crystal is shown in Figure 6.

The wrapper is subject to several geometric requirements, as specified here:

- The wrapper shall lap over itself on the top face of the crystal, and the overlapped portion of the wrapper shall not be skewed out of alignment by more than 0.7 mm at either end.
- So that the wrapper does not interfere with the placement of the machined end cap, neither end of the wrapper shall extend past the end of the crystal.
- The wrapper seam on the top face of the crystal shall be covered with a 312 mm (+0 mm, -1 mm) strip of 12.7 mm wide Kapton tape. The tape length is chosen so that it does not extend beneath the flange of either end cap, but its ends are covered by end-cap mounting tape.

- The wrapper shall be tight after both ends caps are taped in place.
- The end-cap mounting tape shall not extend onto the chamfers of the end cap. This tape shall cover only the lip of the end cap.
- Both end caps shall be firmly seated onto the crystal end faces such that they do not move when modest finger pressure is applied axially to a corner of the end cap.

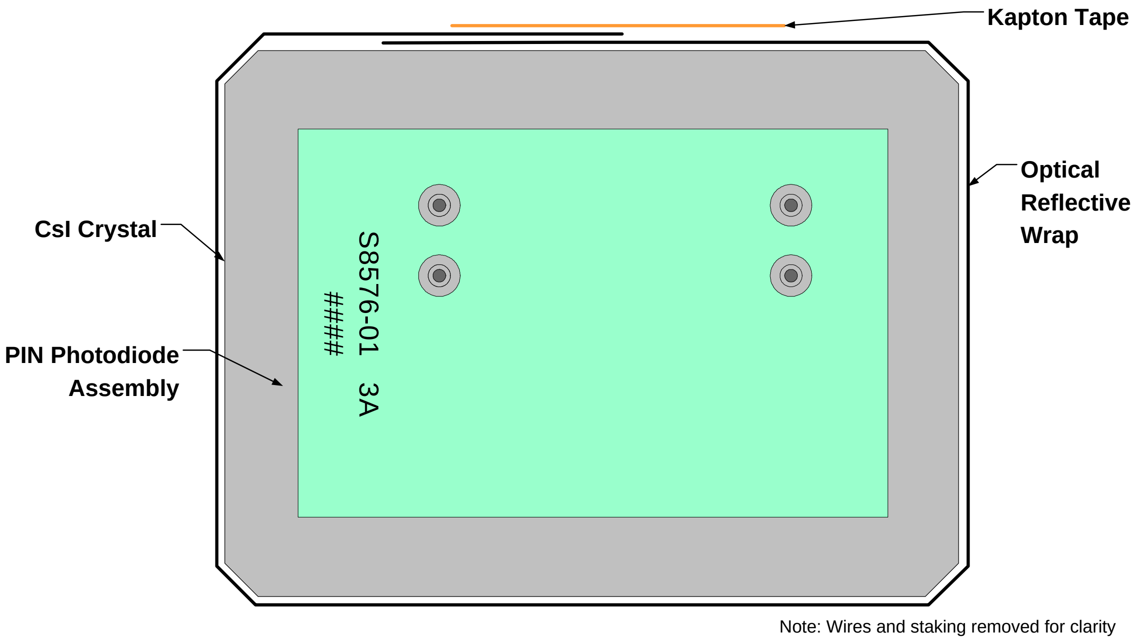

Figure 6. Optical Reflective Wrap Orientation on CsI Crystal

2.4.5 Machined end Caps

The bonded crystal wrapped with reflective material shall be closed out by attaching machined end caps at both ends. The end cap attachment shall be performed in accordance with the Flight CDE Wrapping and Capping Procedure, LAT-PS-01332. Figure 7 shows a picture of the machined end cap. Figure 8 shows the application of the end cap on the finished CDE end.

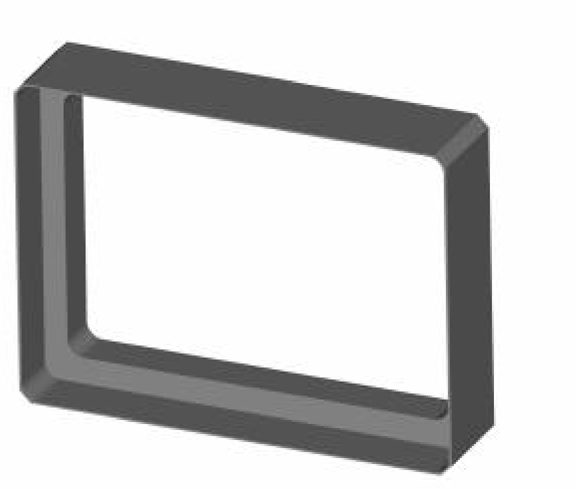

Figure 7. Machined End Cap

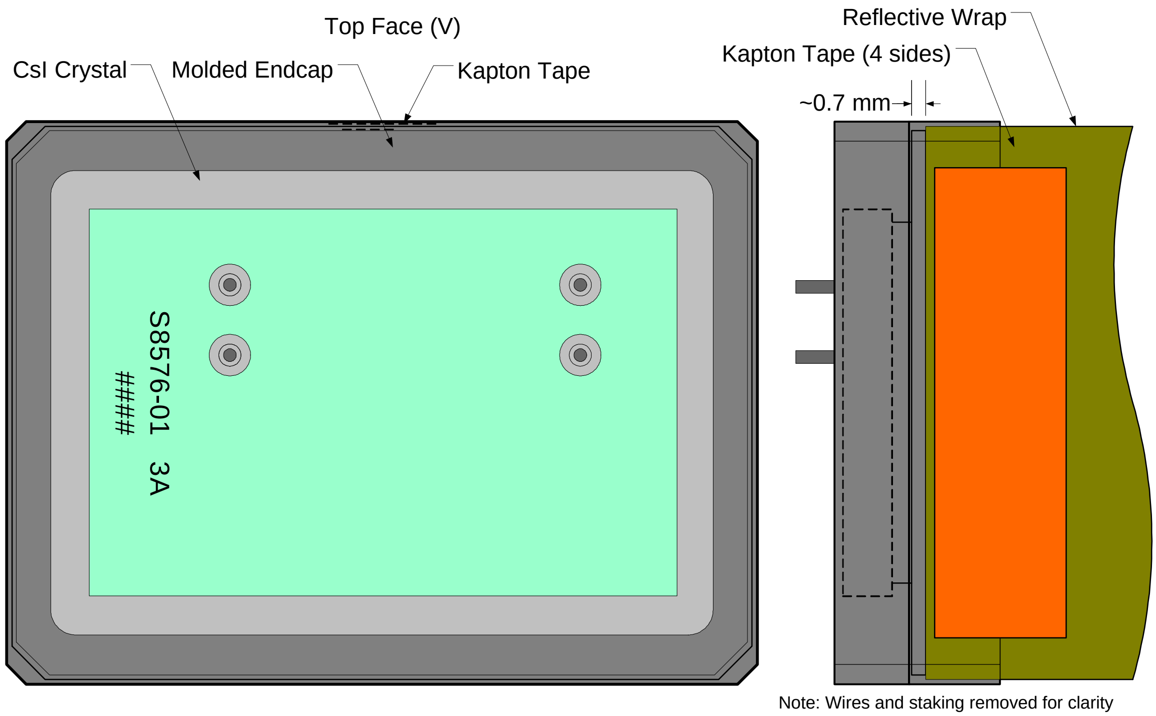

Figure 8. End Cap on CDE End

2.4.6 MECHANICAL SPECIFICATIONS

2.4.6.1 Overall Envelope

Each CDE shall have overall dimensions (including bonded PDAs and Optical Reflective Wrap) not to exceed those given in Table 1. The "CDE Total Length" is defined as the distance between the outside of the PDA assemblies on opposite faces of the crystal, not including the extent of the interconnect wire pairs. These dimensions allow for a minimum 0.1 mm clearance between the CDE and the structure cell walls.

Table 1 . CDE Dimensions

Parameter	Maximum Value (mm)	Minimum Value (mm)
Crystal Length	326.00	325.40
Bonding Thickness	1.00 (x2)	0.80 (x2)
PDA Carrier Thickness	1.96 (x2)	1.60 (x2)
Staking Height above Carrier	2.20 (x2)	2.00 (x2)
CDE Total Length	**336.32**	**334.20**
CDE End Cap Thickness (see note)	2.8 (x2)	2.7 (x2)
CDE Cap-to-Cap Length	**331.60**	**330.80**
Crystal Height	19.90	19.50
Kapton Tape	0.064 (x3)	0.064 (x3)
Wrapping Thickness	0.065 (x3)	0.065 (x3)
CDE Total Height	**20.29**	**19.89**

Parameter	Maximum Value (mm)	Minimum Value (mm)
CDE End Cap Height (see note)	**20.37**	**20.33**
Crystal Width	26.70	26.30
Kapton Tape	0.064 (x2)	0.064 (x2)
Wrapping Thickness	0.065 (x2)	0.065 (x2)
CDE Total Width	**26.96**	**26.56**
CDE End Cap Width (see note)	**27.17**	**27.13**
Distance between Opposing Chamfers	31.78	31.58
Wrapping Thickness	0.065 (x2)	0.065 (x2)
Total Chamfer Distance	**31.91**	**31.71**

Note: Also included in Table 1 are the dimensions for the machined end cap that is to be used to close out the wrapping of the CDE. Since the PDA protrudes through the end cap, the use of the end cap does not affect the total length of the CDE.

2.4.6.2 CDE Mass

The mass of each CDE, including CsI crystal, DPDs, optical bonds, interconnect wire pairs, optical reflective wrap, and machined end caps shall not exceed 0.80 kg, summarized in Table 2.

Table 2. CDE Mass Summary (TBC)

Component	Quantity	Unit Mass (kg)	Total Mass (kg)
CsI Crystal	1	0.7890	0.7890
Dual Photodiodes	2	0.0016	0.0032
Optical Bonds	2	0.0002	0.0004
Interconnect Wires	8	0.0001	0.0008
Solder & Staking	2	0.0008	0.0016
Optical Reflective Wrap	1	0.0033	0.0033
Machined end Caps	2	0.0006	0.0012
Kapton Tape	-	0.0005	0.0005
TOTAL			**0.80**

2.5 IDENTIFICATION AND MARKING

2.5.1 CDE Unique Identification (ID) Code

Each CDE shall be uniquely identified by the serial number of the CsI crystal that was used in the assembly.

This identification code is not visible after integration with the structure. Therefore, this identification code shall be entered into a database that serves as a record of the location of each CDE within the structure and the identifying numbers of the component CsI crystals and DPDs comprising the CDEs.

2.5.2 CDE Marking

Each CDE shall be labeled with its Unique ID Code and an orientation mark by writing on the top surface of the VM2000 reflective wrap of the completed CDE. The orientation mark shall be “(+)”, to indicate the “Plus” face of the completed CDE. As shown in Figure 9, the label shall be located so that the serial number reads from left to right, with the right edge of the orientation mark within 25 mm of the fiducial “V” on the crystal, and so that it is completely covered by the seam-sealing Kapton tape. The total length of the label shall be less than 75 mm. As given in the CsI Crystal Performance Specification (LAT-DS-00820), the fiducial “V” identifies the “top” surface and the “plus” end (which is the “right” end) of the crystal.

Figure 9. Sample CDE Identification Mark

2.6 ENVIRONMENTAL REQUIREMENTS

2.6.1 Thermal and Mechanical Environments

The CDEs shall be designed and manufactured to operate within the thermal and mechanical environments specified in the LAT CAL Level-IV Specification, LAT-SS-00210, Section 8.0, Thermal, and Section 11.0, Environmental.

2.6.2 Outgassing and Contamination

All materials used in the CDE shall meet the outgassing and contamination requirements specified in the Calorimeter, Tracker, and Data Acquisition Contamination Control Plan (LAT MD-00228).

2.6.3 CDE Handling Procedures

CDEs shall be stored, handled, and shipped using controlled procedures that guarantee minimum exposure to structural and mechanical loads and prevent exposure to moist or damp surfaces and environments. These are described in the Crystal and CDE Handling Procedure (LAT-SS-00607).

2.7 QUALITY ASSURANCE PROGRAM REQUIREMENTS

The CDE supplier shall implement a QA program whereby assurance is given that:

- For each configuration item there is a defined and implemented verification approach that makes it possible to demonstrate that the CDE is so assembled that it will perform to the specifications given herein.
- The approach adopted guarantees that the design is producible, repeatable, and verifiable and that the resulting product can be verified and operated within the required operating limits given herein.
- Fabrication, assembly, and test are conducted in a controlled manner so that the end item conforms to approved procedures and test methods.
- Procedures and instructions are established which provide for the identification, segregation, handling, packaging, preservation, storage and transportation of all items.
- The supplier shall implement a traceability system, which shall be maintained throughout all phases of the project and during the planned operational life of the assembly and testing of CDEs.
- The supplier traceability system shall provide for the ability to:
    1. Establish bi-directional and unequivocal relationship between CDE parts / materials / products and associated documentation / records
    2. Trace data, personnel and equipment related to procurement, fabrication, inspection, test, assembly, integration, and operations activities
    3. Trace backwards the location of materials, parts, and subassemblies
- A unique serial number shall identify each CDE.
- The supplier shall control, calibrate and maintain inspection, measuring and test equipment, whether owned by the supplier, or on loan to the supplier, to demonstrate the conformance of CDE to the specified requirements

- The supplier shall establish and maintain a nonconformance control system. The system shall provide for a disciplined approach to the identification and segregation of nonconforming items, the recording, reporting, review, disposition and the definition and implementation of corrective actions.
- The supplier shall prevent handling damage during all phases of manufacturing, assembly, testing, storage, and transportation by adequate protection of items during handling.
- The supplier shall have secure storage areas available for incoming materials, intermediate items during process needing temporary storage, and end items before shipping.
- Inspection and test requirements, including acceptance/reject criteria, shall be developed and expressed in an unambiguous and quantified manner.
- Inspection and test requirements are expressed in an unambiguous and quantified manner including test sequence, test conditions, and accuracy in measurement.

3 CDE RESPONSIBILITIES

(For reference only. Please refer to applicable Memoranda of Agreement and other international documents.)

3.1 CDE Components

The CsI crystals shall be procured and verified from Sweden according to the Calorimeter CsI Crystal Performance Specification, LAT-DS-00820. The procurement of the Machined End Caps shall be the responsibility of IN2P3/Ecole Polytechnique. The remainder of components and assembly shall be the responsibility of NRL.

3.2 GROUND SUPPORT EQUIPMENT

With the exception of the Crystal Optical Testing Station and the crystal mechanical inspection stations, mechanical and electrical Ground Support Equipment required for the CDE production and testing – including assembly fixtures and jigs, shall be the responsibility of NRL.

4 SOFTWARE

Data acquisition and analysis software for the CDE Muon Telescope, which is required for verification of the optical performance of flight CDEs, shall be the responsibility of NRL.

5 DELIVERY

Finished CDEs shall be delivered to the Naval Research Lab at the following address:

Dr. J. Eric Grove phone: +1 202 767 3112
Code 7650
Building 209, Room 325
Naval Research Lab
4555 Overlook Ave SW
Washington, DC 20375

6 VERIFICATION REQUIREMENTS

The requirements for the qualification of the CDE design and process are specified in the document LAT-PS-02336. The acceptance test requirements for all CDE are identified in the document, LAT-PS-02335.